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Impact of resolution increase for seasonal forecast quality in EC-Earth

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SPECS
Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

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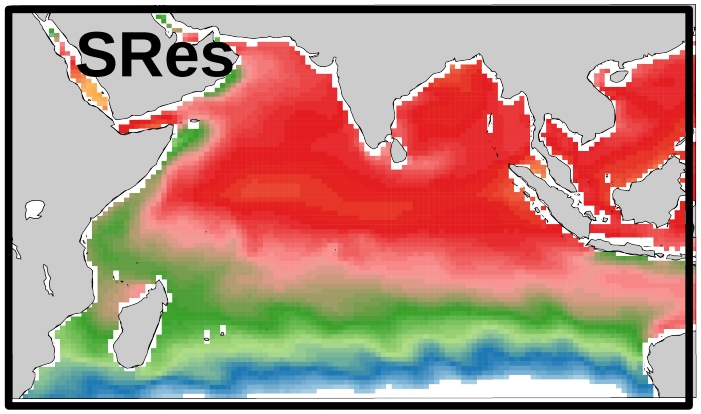
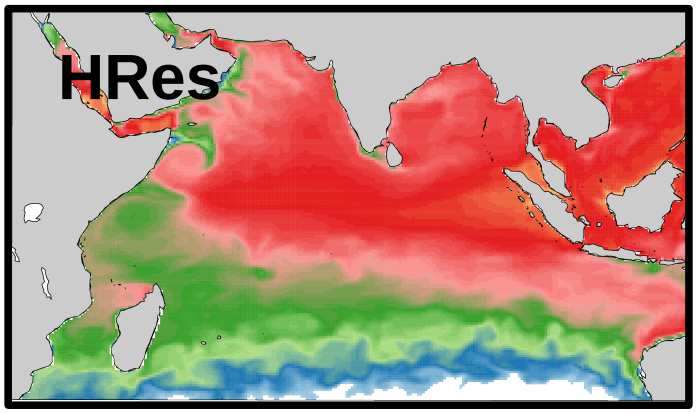
Introduction

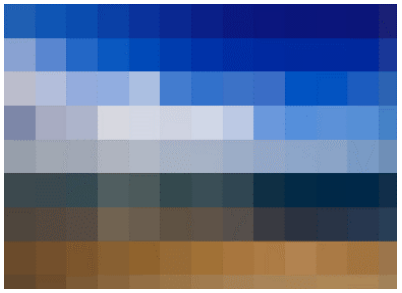




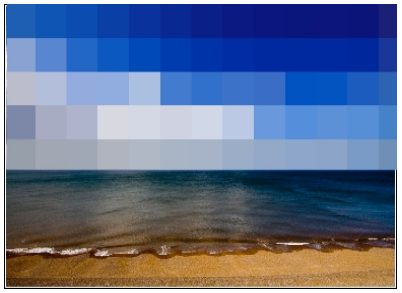
Reference	Shaffrey et al. 2009	Roberts et al. 2009	Scaife et al. 2014	Maclachlan et al. 2015	Branković and Gregory 2001	Jia et al 2015 Yang et al. 2015	Gent et al. 2010	Saka moto et al. 2012	Delworth et al. 2012	Johnson et al. 2016	Zhu et al. 2015
Asian Monsoon					T159: (++) T319: (--)		(++)		(++)	(++)	
Cold Tongue	(++)	(++)					(==)	(++)	(==)		
ENSO	(++)			(==) skill		(++) skill		(++)	(++)		(==)
NAO			(++)	(++)							
Upwelling							(++)	(++)		(++)	

Experimental design

SRes (T255/ORCA1)
1º - 70km



IRes (T255/ORCA025)
0.25º - 70km



IFS cy36r4

NEMO 3.3.2

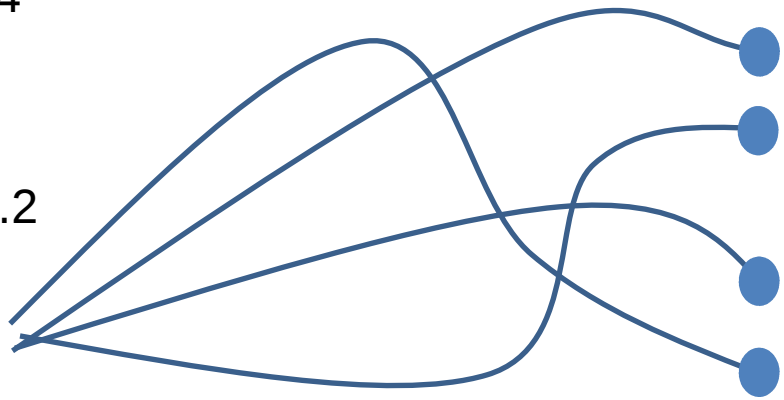
HRes (T511/ORCA025)
0.25º - 40km

Seasonal retrospective hindcasts performed with **EC-Earth 3.0.1**

34 start dates: May and November every year between 1993 and 2009

1st May 1st Nov — 1st May 1st Nov

1993 — **2009**

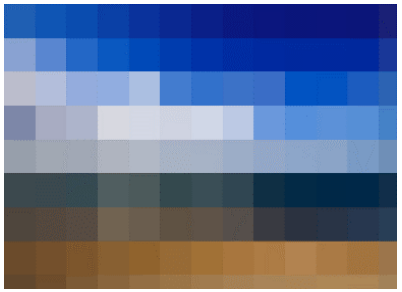


10 members

4-month lead time

Numbers and reminder for fair comparison

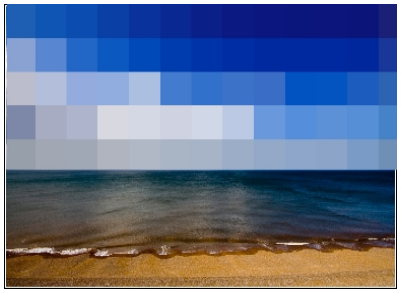
SRes (T255/ORCA1)
1º - 70km



CPU/month/member: 75

x 6

IRes (T255/ORCA025)
0.25º - 70km



CPU/month/member: 493

x 4

HRes (T511/ORCA025)
0.25º - 40km

CPU/month/member: 2256

- The initialization product (GLORYS) is performed at high resolution so the IC have been interpolated.

- SRes had more tuning than IRes and HRes.

- Less tuning had been performed at these resolutions

- Only vertical interpolation for the IC.
- Eddy permitting
- Better coupling (thinner ML)
- Bathymetry

- Better orography…

Impact on the mean climate

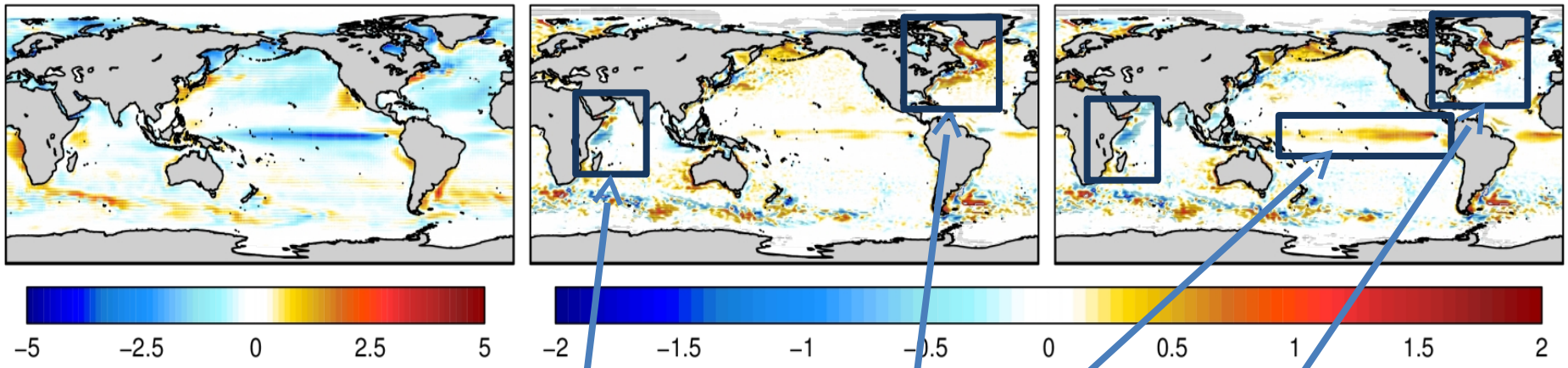
May start dates:
JJA (1 month forecast time)

SST

SRes - ERSST

IRes - SRes

HRes - SRes



Improvement of the Somalian Upwelling

Improvement of the cold tongue bias.

Reduction of the cold bias in the Northern Hemisphere

Impact on the mean climate

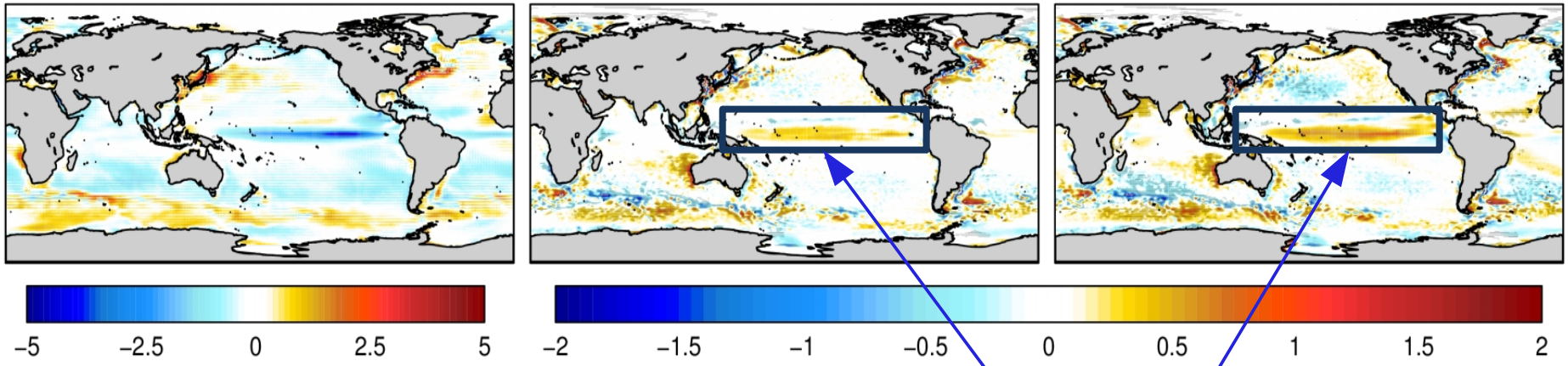
November start dates:
DJF (1 month forecast time)

SST

SRes - ERSST

IRes - SRes

HRes - SRes



Improvement of the cold tongue bias
(stronger in HRes)

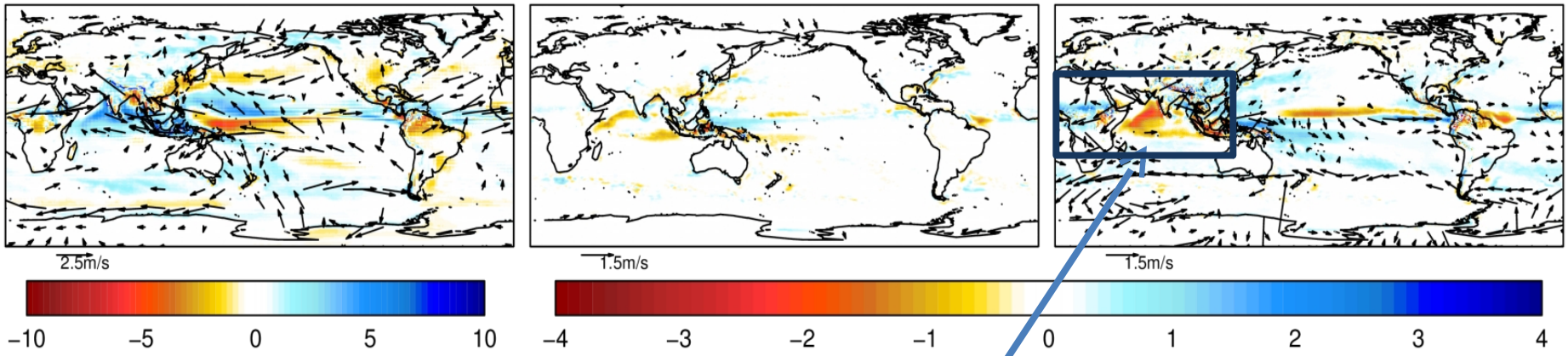
Impact on the mean climate

May start dates:

JJA (1 month forecast time)

Precipitation – wind at 850hPa

SRes - ERSST | IRes - SRes | HRes - SRes

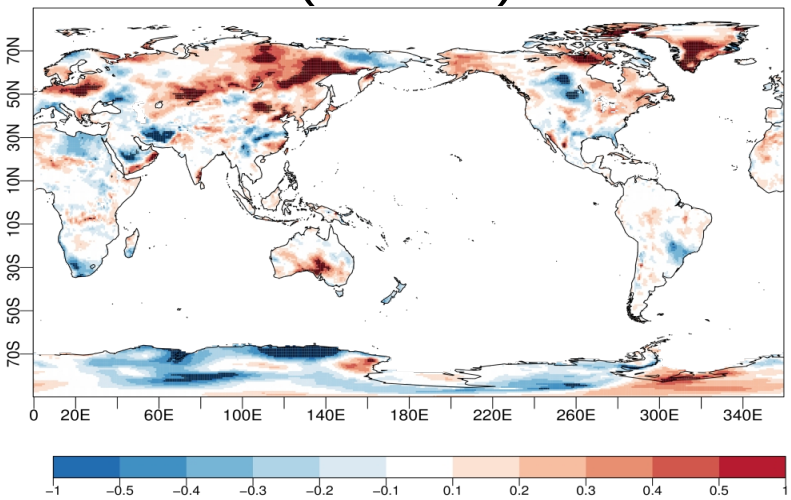


Change in the African and Indian monsoon:
- reduction of excessive oceanic precipitation in the Indian Ocean
- no improvement for land precipitation

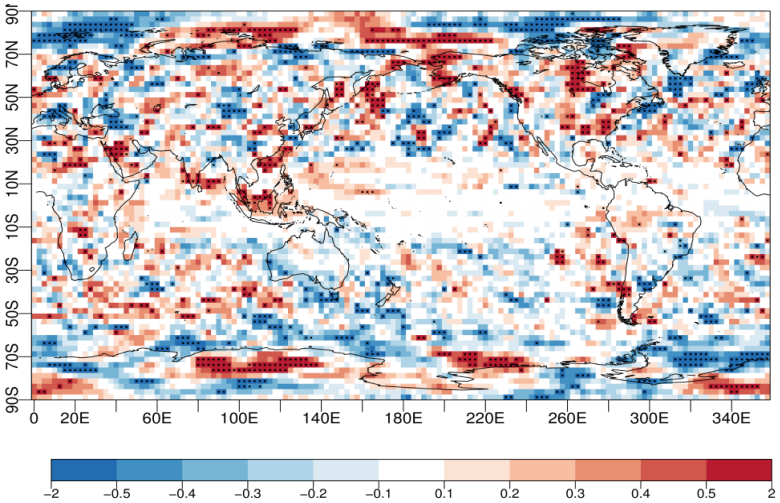
Impact on skill: Correlation HRes-SRes

Forecast initialized in May (1 month forecast time)

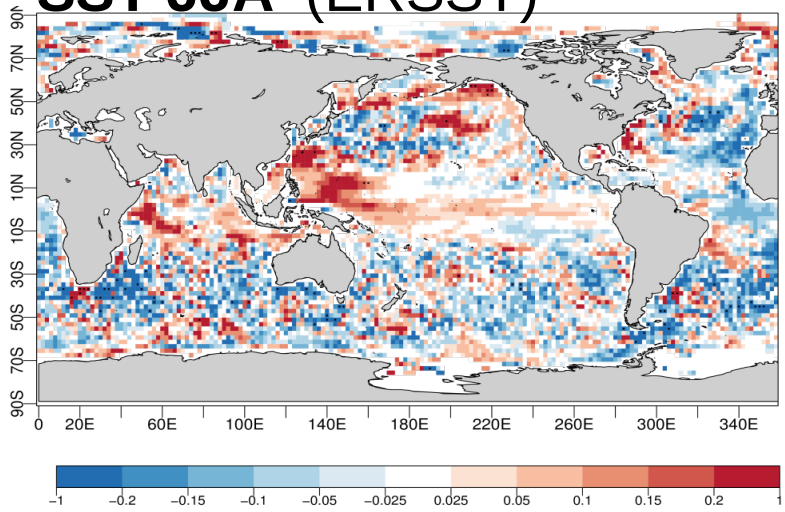
T2m JJA (ERAint)



Precip JJA (GPCP)

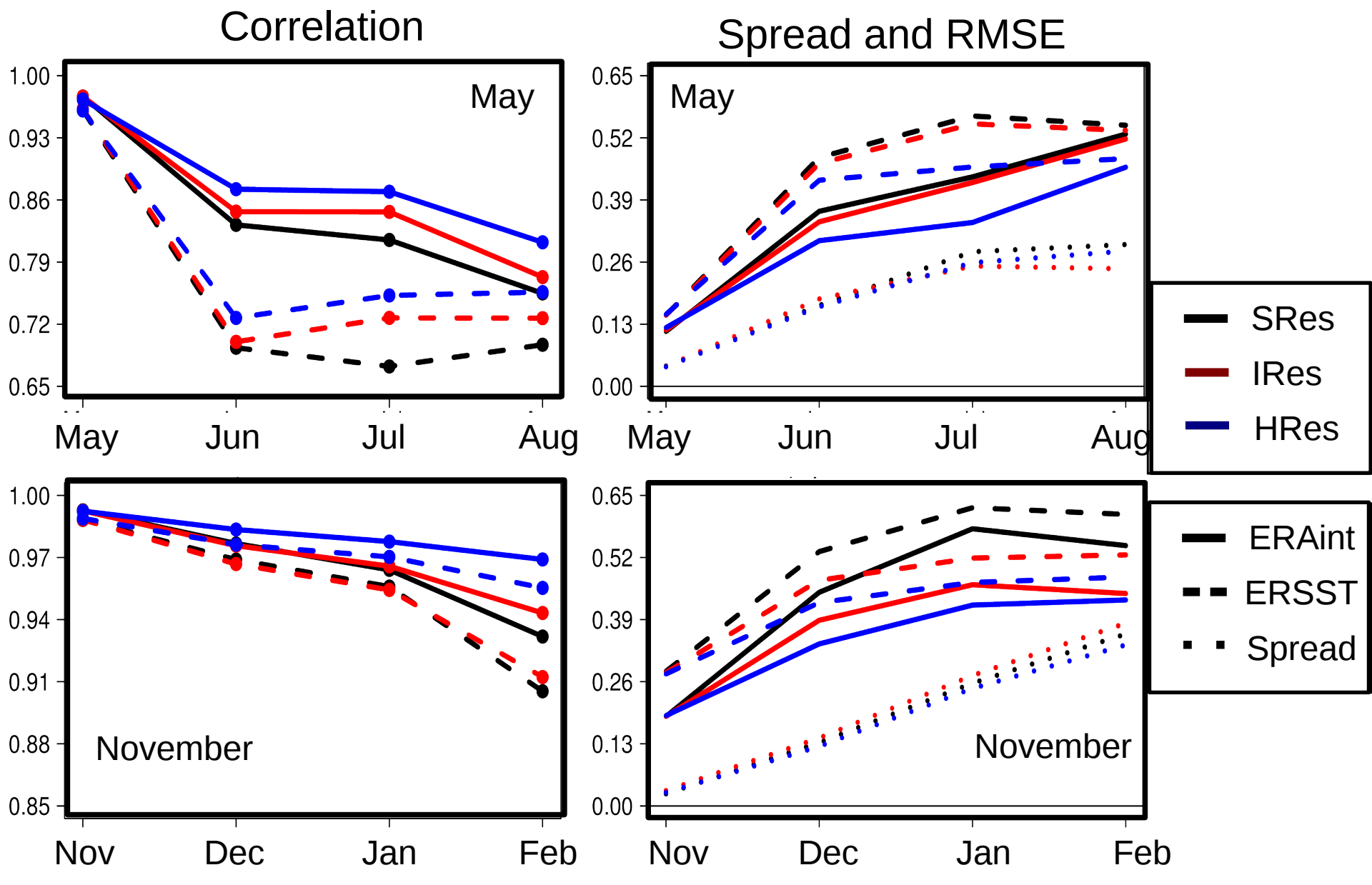


SST JJA (ERSST)

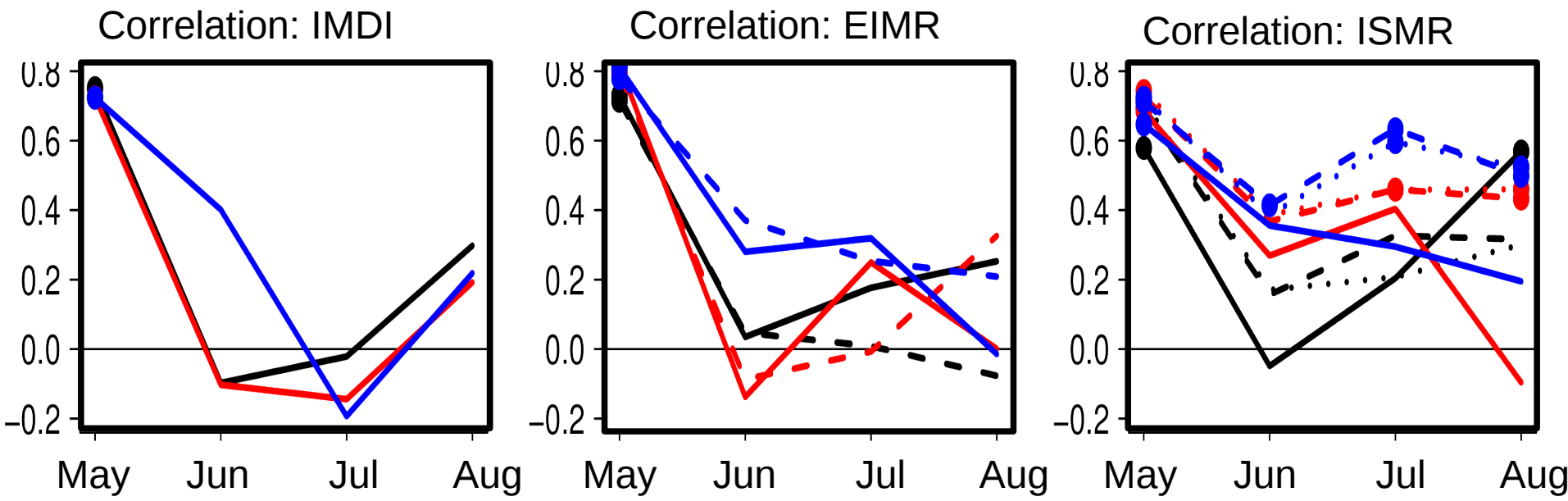


Skill changes are noisy and no improvement is detected at grid point level.
Similar conclusion for winter.

Impact on skill: Niño 3.4



Impact on skill: Indian Monsoon

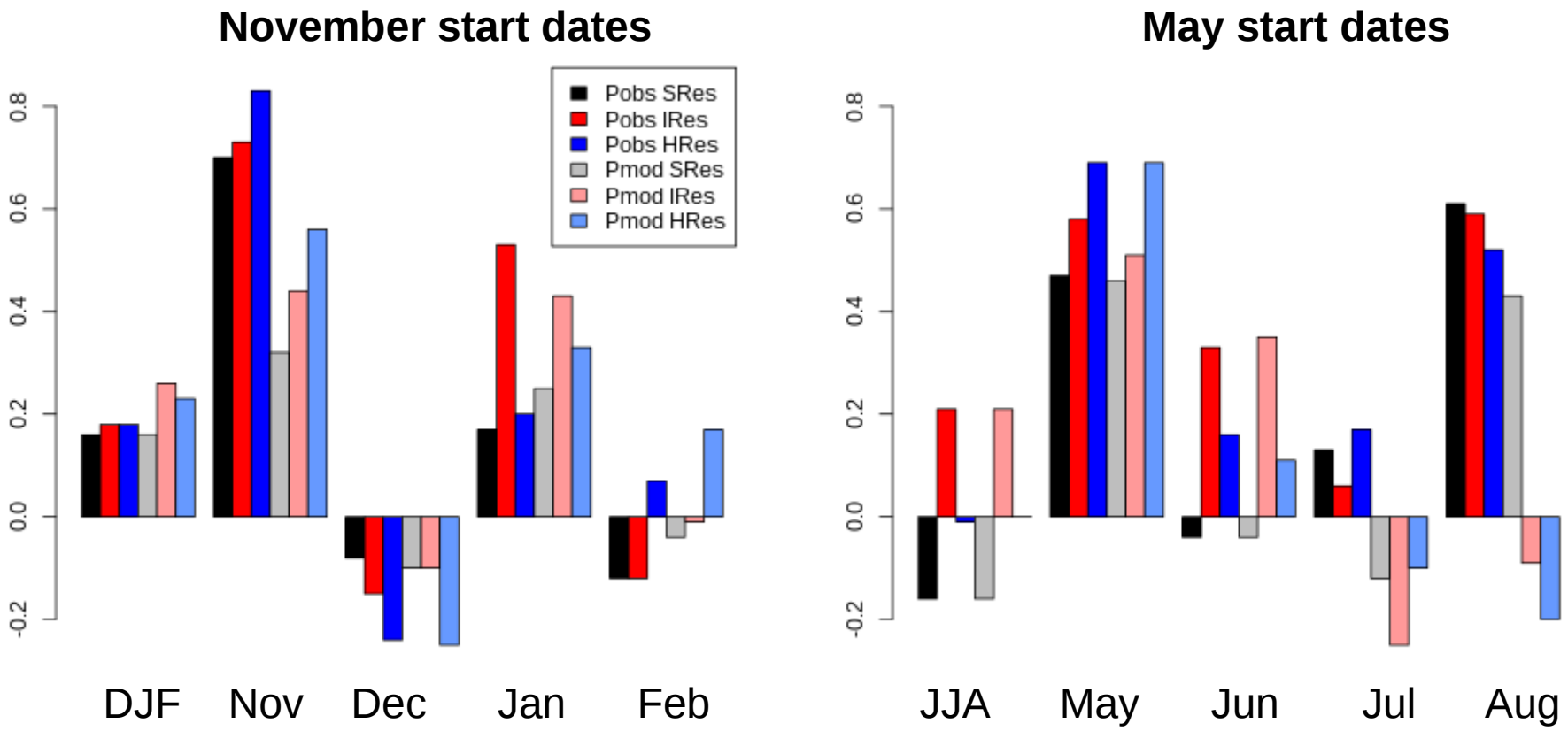


Onset date Correlation:
SRes: 0.61
IRes: 0.69
HRes: 0.65

SRes
IRes
HRes

ERA-Interim
GPCP
GPCC

North Atlantic Oscillation



Summary

- Increase of both oceanic and atmospheric resolution improves the representation of the mean state.

	SST	Land T2M	Precipitation	Land precip
May	**61.5%**	**57.6%**	**50.5%**	**59.5%**
November	**60.2%**	**60.7%**	**55.3%**	**60.2%**

Summary

- Increase of both oceanic and atmospheric resolution improves the representation of the mean state.

	SST	Land T2M	Precipitation	Land precip
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November	**60.2%**	**60.7%**	**55.3%**	**60.2%**

- Grid-point skill changes are sparse and noisy.

	SST	Land T2M	Precipitation	Land precip
May	**47.8%**	**53.7%**	**50.6%**	**50.3%**
November	**43.2%**	**48.3%**	**51.6%**	**55.4%**

- The skill of ENSO and of the early stages of the Indian monsoon is improved when the resolution is increased.

- Slight improvements of NAO, sea-ice, blocking (not shown here).

Conclusions and open questions...

- **The increase of resolution does not lead to any spectacular improvements but to an addition of small improvements (more details available in the paper).**

- The numbers of start dates and members we are using is relatively small, is this enough to detect improvement in high latitude?

- Would an additional tuning and improvement of initial conditions lead to further improvements?

- This research line is extremely expensive in term of computing, an additional work on model performance and scalability is essential to pursue in this direction.

.

And if you want to know more....

Paper accepted in **Journal of Climate**, with lot of additional results on sea ice and blocking...

C. Prodhomme, L. Batté, F. Massonnet, F. Massonnet, P. Davini, O. Bellprat, V. Guemas, F. Doblas-Reyes.
Benefits of resolution increase for seasonal forecast quality in EC-Earth. Journal of Climate. In Press.

Thanks for your attention!

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Thank you!

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